**Lab: Chromatography**

**Introduction**

In this lab, you will be designing and carrying out an experiment in order to identify and characterize the dyes found in food colouring including red, orange, yellow, green, blue, and purple.

The use of colour additives became more prominent with industrialization as food became more commonly mass produced and often had to be transported long distances and stored for longer periods of time. Food dyes were used to make food more visually appealing to consumers. Dyes were initially added to foods with little or no testing on the potential health effects. In 1907, the United States Department of Agriculture (USDA) began testing the adverse effects of dyes and many were found to be harmful or toxic. Today, only seven food colourings are approved for use by the Federal Food, Drug, and Cosmetic Act (FD&C). Those food colourings are shown in the table below.

Commercially available food colouring is a solution of various dyes, depending on the colour. In this lab, the dyes contained in different colours of food colouring will be separated and identified using paper chromatography. The solvent that will be prepared for the chromatography experiments is 0.10 % salt solution. The accepted retention factors for each FD&C dye are shown on the table below.

| FD&C Identity | Chemical Name | Accepted $R_f$ value in 0.10% salt solution |
|---|---|---|
| Blue No. 1 | Brilliant Blue | 0.90 |
| Blue No. 2 | Indigotine | 0.35 |
| Green No. 3 | Fast Green | 0.95 |
| Red No. 40 | Allura Red | 0.80 |
| Red No. 3 | Erythrosine | 0.30 |
| Yellow No. 5 | Tartrazine | 0.85 |
| Yellow No. 6 | Sunset Yellow | 0.75 |

Some of the dyes may be present in more than one colour of food colouring; some of the dyes may not be present in any of the colours of food colouring. You will be given three days of class time to design your procedure, carry out your experiment, and analyze your results.

**Available Materials**

- food colouring (red, orange, yellow, blue, green, and purple)
- three toothpicks
- 400 mL beaker (for chromatography chamber)
- 250 mL beaker (to prepare solvent)
- one coffee filter (to prepare six chromatography strips 13 cm x 1.5 cm)
- glass stir rod
- paper clips
- ruler
- pair of scissors
- 50 mL Graduated cylinder
- eyedropper
- 2 mL of 20% salt solution

**Procedure**
Using the list of materials provided, your group will write a procedure outlining the steps that need to be carried out, including all measurements that need to be recorded, and present these steps to your teacher for approval. Your procedure should also include any supporting calculations used in the design. Once the procedure has been approved, your lab group can begin the experiment.

Your procedure should address the following questions:
- how will the 0.10% salt solution be prepared, using all of the provided 20% salt solution? (hint: perform this process with two dilutions, preparing first a solution of intermediate concentration of 1.0 %. Not all of the 1.0% solution will be needed for the subsequent dilution. No step should require a volume measurement larger than 50 mL.)
- how will the chromatography strips be prepared?
- how will the food colouring be added to the chromatography strip? (hint: use small drops of food colouring in order to see the separation of colours more completely)
- how will the chromatography strip be held in the beaker?
- how will the distance travelled by the solvent be determined?
- how will the distance travelled by the dyes be determined?
- how will the $R_f$ value for each dye be calculated?
- how will the FD&C dyes used in each colour of food colouring be identified?

**Laboratory Report Poster**
Each group will submit a **poster** following the guidelines outlined below.

The final poster will be due on _____.

**Purpose**
Write one sentence to describe the objective of the lab.

**Procedure**
Attach your graded procedure to the poster.

**Data**
Record all collected data/observations in a data table (typed or neatly drawn with a ruler). You will need to make both quantitative (i.e. distances travelled) and qualitative (i.e. colours seen) observations. Attach the chromatography strips for each food colouring to your poster.

**Calculations and Discussion**
Show all calculations used in designing the procedure (i.e. preparing the solvent) and analyzing the results (i.e. determining the retention factor for each dye). *Explain* what the retention factor tells you about the relative affinity of a dye for the mobile phase and the stationary phase, using examples from the lab. How does the retention factor relate to the polarity/molecular structure of the dyes?

**Conclusion**
Summarize the dyes used to make each colour of food colouring in the form of a table.